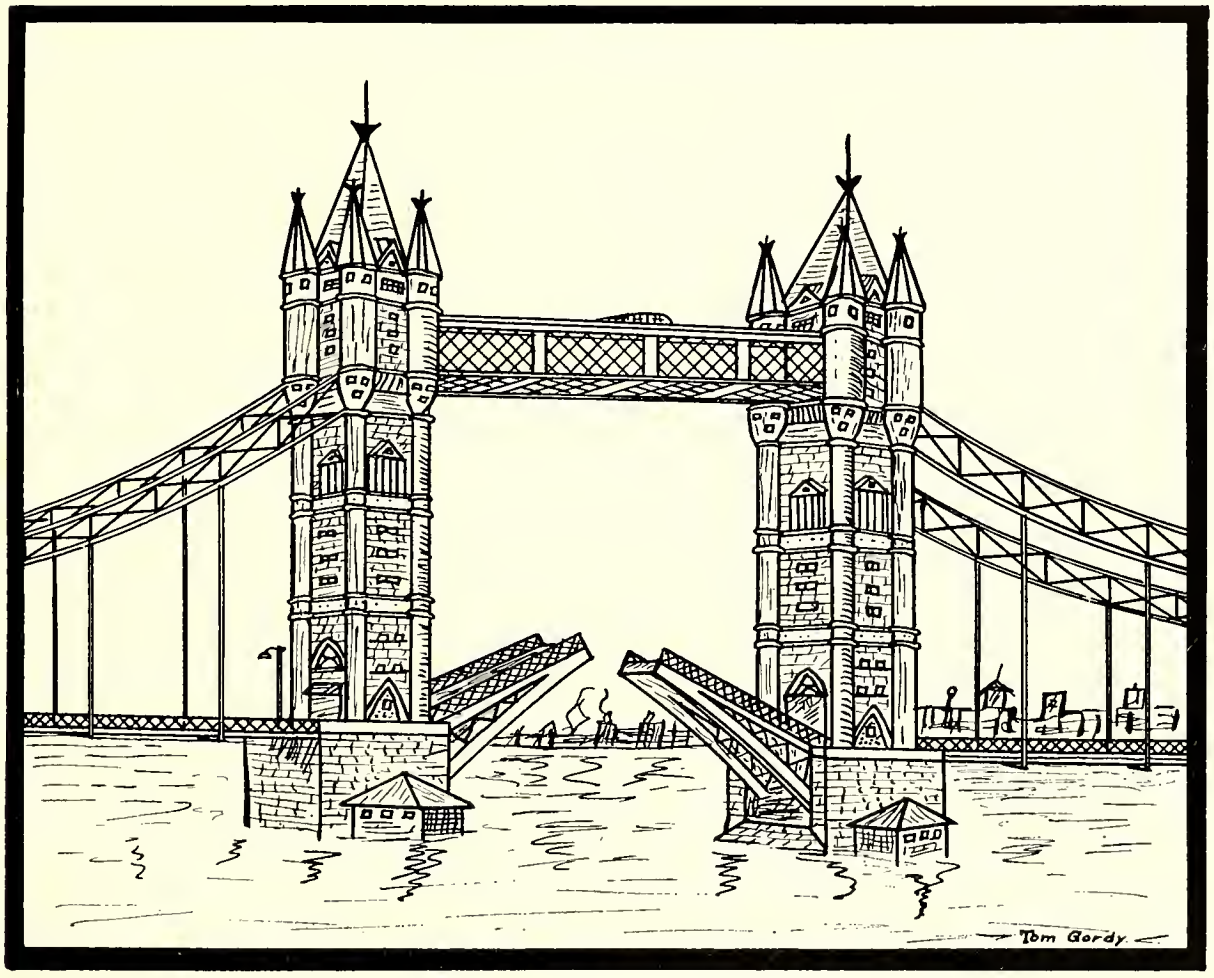
The Carolina Engineer



SCHOOL OF ENGINEERING
University of North Carolina

NOVEMBER, 1933

VOLUME 2 NUMBER 1

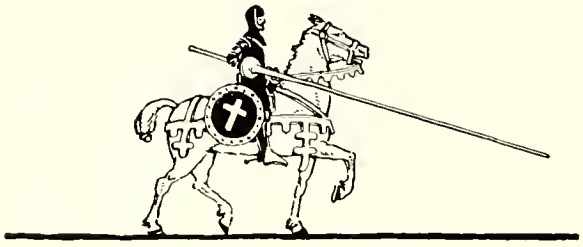
G-E *Campus News*

TALK FOR TRAINS

On a track near Schenectady, a few weeks ago, several visiting trade-journalists sat in a test car. From a loudspeaker in this car came a running stream of information. The voice was that of a G-E engineer in a "station" a half-mile down the track. Sample remarks:

"Believing that we could help railroads to speed the movement of freight trains, G.E. has now produced this device — a new system of communication. It's not radio, but, in principle, direct telephony. It's a distant cousin of the carrier-current communication that power companies use. They talk over the power lines; we use the rails, plus any wire line along the track. Now, the man in the caboose can talk with the man in the cab. It also works between trains up to 5 miles apart, and between trains and stations. Loudspeaker reception overcomes the train noises. Can you hear me all right?" They could.

Dr. Ernst Alexanderson, a G-E Consulting Engineer, is responsible for this development. He is a 1900 graduate of the Kungliga Tekniska Högskolan, Stockholm, Sweden. Incidentally, a partial indication of his versatility in engineering design will be found in the U.S. Patent Office, through which he has been granted more than 200 patents.

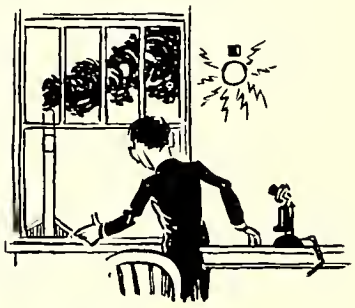


A RÖNTGEN WARRIOR

For the doctors who are waging continuous warfare against the dread, lurking specter of cancer, G-E research men believe they have provided another shining sword. Again they have produced the most powerful x-ray tube ever built—this time, for continuous operation in practical cancer therapy at the Mercy Hospital, Chicago. Dr. E. E. Charlton, Grinnell College, '13, is the man who directed the production of this tube.

The giant tube (brother under the glass to those in your radio) measures more than 14 feet in length, is rated 800,000 volts, will treat patients in a fraction of the time required by the last "most powerful" one, has x-ray radiation equivalent to $75,000,000 worth of radium (if there is that much!) and needs 20 gallons of Lake Michigan's coldest water every minute to keep cool.

It's a pleasure to make good motors and good lamps. It's a greater pleasure to help alleviate human ills—all in the line of duty! More tubes are on the way.



SMOKE IN THE EYE

An eye in the stack is worth two on the ground. So thought G-E engineers as they finished mulling over the smoke-nuisance problem of power and heating plants.

A light source and a photoelectric-relay unit were installed in stacks in Chicago and New Jersey. They are so arranged that when the stack is clear, light falls on the phototube; a meter or recording instrument registers zero smoke density. As the density increases, the phototube receives less light and indicates an increase in density. An adjustable electric contact is provided to operate an alarm. (A running record of the amount of smoke passed up the stack could be obtained by adding a recorder.) Thus, the "electric-eye," which is not affected by cinders and is never closed in sleep, has found another way to be of service.

Two G-E engineers, W. R. King and Pieter Juchter, developed this new smoke-density indicator. King is a '28 graduate of the U. of Kentucky, and Juchter a '24 graduate of the Eidgenössische Technische Hochschule, Zürich, Switzerland.

NRA WE DO OUR PART

96-4DH

GENERAL ELECTRIC

The Carolina Engineer

The Professional Journal of the School of Engineering

University of North Carolina

VOLUME II NOVEMBER, 1933 NUMBER 1

CONTENTS

COVER: "Tower Bridge, London, England,"
Drawing by Tom Gordy.

Editorial 2

The History of Communication, *J. R. Marvin* 3

The Hydrogen Isotopes, *E. L. Laxton* 5

Transformers, Operation and Testing, *F. M. Glover, Jr.* 7

Miller Becomes Dean; Baity is State Engineer, *E. A. Gaskill, Jr.* 8

The Purification of Sodium Chloride, *Blair Holliday* 9

Activities of the Engineering Societies 11

With the Alumni 12

STAFF

EDITORIAL

W. E. Davis—*Editor*
E. A. Gaskill, Jr.—*Associate from A. I. Ch.E.*
W. L. Ridenhour—*Associate from A. I. E. E.*
W. W. King—*Associate from A. S. C. E.*
E. L. Kendrick—*Associate from A. S. M. E.*
F. M. Glover, Jr.—*Alumni Editor*
Tom Gordy—*Illustrations Editor*
Robert Van Sleen—*Exchange Editor*

BUSINESS

H. F. Stewart—*Business Manager*
M. E. Evans—*Advertising Manager*
H. C. McBriar—*Asst. Advertising Manager*
Eugene Carland—*Publication Manager*
S. H. Usry—*Circulation Manager*
C. Atkinson—*Asst. Circulation Manager*
S. E. Combs—*Asst. Circulation Manager*

Published in the months of March, May, and November by the students of the School of Engineering, University of North Carolina, Chapel Hill, N. C. All correspondence should be addressed to the Carolina Engineer, Box 610, University of North Carolina, Chapel Hill, N. C.

PRICE: 50c A COPY; $1.00 A YEAR

E·D·I·T·O·R·I·A·L

W. E. Davis—*Editor*

THE NEW REGIME

It is with hope, but without illusions, that the new staff accepts responsibility for The Carolina Engineer for the coming year. Too often, incoming editors are imbued with idealistic plans which are impossible of attainment. The present staff has no such illusions. Its program can be stated in a few words. Briefly, it is to leave the magazine in a better condition at the end of the year than at the beginning.

Such a program may, to the more cynical, seem nothing but an empty phrase. To disprove this a few of the aims of the staff may well be stated here. The first of these is the attainment of membership in Engineering College Magazines Associated, whose membership is constituted of the members of which body constitute magazines published by the more important engineering colleges in the country. The staff does not promise it will attain membership this year —such a matter requires more time. However, a few requirements for membership have already been met, and the present staff hopes to meet others. One requirement—that the magazine shall have a permanent faculty advisor—has been met by the election of Dr. A. C. Howell to this position, which he has kindly accepted. At least 30 per cent of the Engineering School subscribes to the magazine, automatically fulfilling another requirement of the association. A drive has been begun to secure a total of 300 subscribers by the end of the year, to fulfill still another requirement.

One cardinal aim of the staff is to make the contents of the magazine interesting and lively. Although the educational value of the magazine is not to be neglected, an attempt will be made to introduce features of a non-technical, popular nature. The inclusion of an alumni column and the use of what might be termed "Engineering Oddities" as fillers in this issue indicate the nature of this attempt.

It is only fitting that in the first issue of The Carolina Engineer by the new staff, the policies of the magazine should be explained. The Carolina Engineer is a magazine created and financed by the *students* of the Engineering School. As such, the magazine will be published and controlled according to the wishes of the students. The principal positions on the staff are filled by popular vote of the students. The editor and business manager are chosen by the engineering school as a whole. Each of the four associate editors is elected by the students in his particular engineering society. The remainder of the staff is chosen by the elected men from those students showing the greatest interest and ability in the work of the magazine.

All students may compete for positions on the staff on equal terms. No discrimination is shown as to class. The present staff has members of the freshman, sophomore, junior, and senior classes. Underclassmen are especially urged to submit articles for publication in the magazine.

Finally, it may be well to state that The Carolina Engineer is, in no way, controlled by the faculty. The advice and suggestions of faculty members will always be welcomed by the staff, but these suggestions will not be permitted to take the form of censorship. The faculty has evinced no such desire, and this attitude is greatly appreciated. Articles by faculty members for publication are invited, but they will be accepted on the same basis as those submitted by students. Such articles will not be published unless truly meritorious.

With these hopes and plans, the present staff takes charge of the magazine for the coming year. No foolish promises are made, but something *will* be accomplished to better The Carolina Engineer.

THE ENGINEERS' BALL

Several students have suggested lately a proposal concerning the annual Engineers' Ball, which may have far-reaching effects on the success of the dance. This proposal is to make the dance closed—that is, to admit no students other than those of the Engineering School. Only one ticket would be sold to each engineer. Such a dance has never been held by the engineers heretofore. In the past, each engineer was sold two tickets, one of which he could use himself; the other he could sell or give away to outsiders. No attempt was made to prevent outsiders from participating. This proposal will be discussed at a general meeting of the engineering school to be held immediately after the Thanksgiving holidays.

The advantages which would result from making the dance a closed one are numerous. For one thing, it is believed that admitting only engineers would tend to increase greatly the prestige of the dance. In the past, the number of outsiders admitted to the dance has been large. Virtually none of these outsiders have brought

(Continued on page 15)

THE CAROLINA ENGINEER

VOLUME II NOVEMBER, 1933 NUMBER 1

The History of Communication

By J. R. Marvin

(Editor's Note: The following is a condensed form of the paper presented by the writer at the state meeting of the A. I. E. E. in Chapel Hill, November 1. It is regretted that space requirements do not permit the inclusion of the paper in its entirety.)

One puff of smoke, then two more puffs, and again two more, and then one puff arose. So ran the signals made by the Picts beyond the Roman wall. Their smoke puffs were seen by the sentries of the legions, but the signallers were invisible and their meaning unguessed. And, so for thousands of years before had savage peoples signalled their tidings of peace and war. The antiquity of signalling as a means of communication is undoubted and its lineage is long and illustrious. For centuries its chief purpose was to convey news of great events over great distances. Its older forms, which are prehistoric, must be numbered among those savage arts that civilization kills but cannot emulate.

The first suggestion of an attempt to use electricity as a means of communication was in 1558. The system described was based on the rumor that a sympathetic needle could be used to transmit messages over a long distance. Both transmitter and receiver consisted of a needle shaped piece of steel mounted at the center of a dial having letters marked on the outer edge. It was assumed that if both needles were magnetized by rubbing with the same loadstone a movement of one needle would cause a synchronous movement of the other. The system of course would not work.

Electrical currents were made available for experimentation when Volta invented the electric cell in 1800. Current was first probably used to transmit intelligence by Salva in 1805 and by Soemmering in 1809. These men determined the signals at the receiving end by passing the current between electrodes immersed in water and detecting the presence of gas bubbles as the water decomposed.

The telegraph system of Wheatstone and Cooke depended upon the deflecting needle principle discovered by Ampere. It consisted essentially of a loop of wire within which was suspended a magnetized needle; the needle could be deflected to the right or left by closing a switch at the distant station and passing a current through the receiving loop in one direction or the other. As originally invented in 1837, five separate circuits and needles with a sixth wire as a common return were used. Later, in 1845, a one-wire system was perfected. This needle telegraph of Wheatstone and Cooke was used commercially in England in railway operation during about the same period Morse was developing his equipment in America. Later it was completely supplanted by the Morse system.

On a return trip from Europe, where he had been studying art in 1832, Morse got the idea of the telegraph. A fellow passenger, Dr. Jackson, showed Morse an electromagnet and performed some experiments with it. Before leaving the ship Morse drew up plans for the telegraph and told the captain on leaving: "Should you hear of the telegraph one of these days as the wonder of the world, remember that the discovery was made aboard the good ship *Sully*."

In his early devices, the sending switch was operated by drawing beneath it either a notched bar or a bar in which pegs were arranged in accordance with a code. In this manner signals were sent to the receiving device in a readily predetermined order.

The receiving system consisted essentially of an electromagnet operating an armature carrying a pencil or other marking device which recorded on a paper tape the signals sent by the sending bar. This was another important principle that has found important use, especially in submarine cable telegraph work.

In 1834 Congress appropriated $30,000 for building an experimental line from Washington to Baltimore. The first line was underground and failed because of faulty insulation, but an aerial line was built and in May, 1844, the memorable words, "What hath God wrought?" were transmitted.

Recently, conspicuous success has attended the development of the tone frequency multiplex telegraph. In this system, sine waves of 12 or more different frequencies falling within the voice range are generated, and the transmission of each frequency is controlled by a telegraph transmitter. The waves pass simultaneously over the line and each is separated out by a suitable filter

at the receiving end and passed into the corresponding receiving instrument. Such systems utilize ordinary telephone circuits in trunk cables in a perfectly normal way. For telephone circuits not going below frequencies of 200 cycles, a tone frequency telegraph channel not going above 80-100 words a minute can be superimposed on the telephone channel without interfering with the telephones communication. Tone frequency telegraph can also be transmitted over phantom circuits that cannot be used for telephony because of the high cost of loading them for telephone transmission.

At present much of the newspaper press communications are carried over teletype systems, and just recently the A.T.&T. Co. has inaugurated a system of private teletype exchanges and communication facilities for business concerns.

The first Atlantic submarine cable was laid in 1866 by Charles Bright, who was backed by Cyrus W. Field. Up until a few years ago, submarine cables were limited in speed to 40 words per minute, but the cable laid by the Western Union Co. between New York and Penzance, in which the copper conductors are loaded by a wrapping of permalloy, is capable of a speed of 400 words per minute.

In taking up the history of the telephone, the question naturally arises: how old is the telephone? An article in vol. 15 of *Telephony* has this to say about the telephone's age:

"How old is the telephone? An ingeneous Frenchman—M. Henry Pacory by name—has evolved a theory that the ancient Egyptians had an instrument that transmitted the human voice. However, for all practical purposes, electric telephony dates from Alexander Graham Bell's invention of the electro-magnetic transmitter-rereiver in 1876, 45 years after Faraday's discovery of electro-magnetic induction. Becoming interested in electricity and acoustics, Bell began experimenting with a method of harmonic telegraph transmission using tuned-reed transmitters and receivers. Bell's original conception of the telephone came from the imperfect operation of one of his tuned-reed transmitters, and thereafter he devoted the major part of his time and experiments to devising a method of transmitting speech over wires.

His first successful transmission of speech was made with an electrolytic transmitter and a tuned-reed receiver. The transmitter consisted of a diaphragm having attached to its center a metal rod projecting downward into a small cup of acidulated water. This apparatus was connected in the circuit by connecting one line wire to the rod and one to the cup. Vibrations of the diaphragm caused the amount of the rod dipping in the acidulated water to vary, thus varying the resistance of the circuit in proportion to the intensity of the sound waves striking the diaphragm.

The tuned-reed receiver was improved until it had essentially the same form as the telephone receiver of today. Bell then discovered that the receiver could be used both as transmitter and receiver, and for a while this was the system used —one instrument being used for transmitting and receiving. As a telephone receiver it still remains in universal use with very little change, but as a transmitter it was very soon superseded by loose-contact devices which in the modern commercial microphone take the form of a small cell filled with carbon granules which alter their resistance in accordance with variations of pressure impressed upon them by the sound waves of speech.

The longest distance over which any telephone conversation has been carried is approximately 14,000 miles, this feat being performed as a test in 1928. The route ran from Stockholm via Berlin to Amsterdam and London and thence by radio to New York. From New York it went to Chicago, to San Francisco, to Los Angeles, and back to New York, then once more to Chicago and back to New York. The transmission equivalent of the chain of circuits used was approximately 240 bels, and the relationship of power sent to power received over a circuit of 240 bels is a ratio of 1 to 10 raised to the minus 240th power. To deliver one micro-watt, which is of the order of the amount of power delivered to a receiver to be heard as intelligible speech, at the end of a circuit of 240 bels without intermediate amplification would require the inconceivable amount of power of 10 to the 231st power (10^{231}) kilowatts. In simple words, the number of kilowatts required would be represented by a number written as a one followed by 231 zeros! The power radiated by the sun is of the order of 4x10 to the 29th power ($4x10^{29}$) kilowatts, and accepting Huber's statement that the maximum number of suns within the limiting curve of space is 2x10 to the 24th power ($2x10^{24}$), it follows that the total radiant energy of nature would have to be multiplied by approximately 10 to the 177th power (10^{177}), in other words it would require the energy of 0.25x10 to the 202nd power ($0.25x10^{202}$) suns. From this it seems evident that the invention of the telephone repeater has tended to simplify certain communication problems.

As with all other methods of electrical communication, the radio is based on Faraday's discovery, in 1931, of the principle of electro-mag-

(Continued on page 14)

The Hydrogen Isotopes

By E. L. Laxton

It has been discovered that an element may have two or more kinds of atoms, alike in respect to the numbers of electrons outside of the nucleus, but different as to their nuclei. The chemical properties of such atoms are exactly alike and the different kinds of atoms appear to be the same element. Since, however, there is a difference in their atomic weights, they are not, in reality, identical. There are, for example, two kinds of chlorine atoms with different atomic weights, and more than one kind of lead atoms. The word "isotopes" is used to describe atoms which have the same atomic number but different atomic weights.

Aston has recently shown that many elements are isotopic. The method employed by him was that of positive ray analysis (Fig. 1). The positive rays from a discharge tube are sorted out into a thin ribbon by means of the two slits, S_1 and S_2, and are there passed between the oppositely charged plates, P_1 and P_2. The rays are deflected towards the negative plate, P_2, and are spread out into an electric spectrum. A portion of this spectrum reflected through a given angle is selected by the diaphragm, D, and passed between the circular poles of a powerful electromagnet, O, the field of which bends the rays back again to fall on a photographic plate as shown. If all the rays with a single charge have the same mass, they will converge to a focus at F. If, however, the rays are derived from an element which consists of a mixture of isotopes, each isotope is distinguished by a separate band on the photographic plate. From the relative position of each band, the mass of the atom to which it corresponds can be deduced.

Chlorine (atomic weight 35.457) examined this way shows itself to be a mixture of two isotopes with atomic weights of exactly 35 and 37. Bromine (atomic weight 79.92) gives isotopes of weights 79 and 81. Argon (39.9) is mostly 40 with a trace of 36; potassium (39.1) is mostly 39 with a very little of 41. Mercury (200.6) appears to exist in as many as six forms, with atomic weights ranging from 197 to 204, and tin (118.7) is a mixture of no fewer than eleven isotopes with atomic weights ranging from 112 to 124!

It is quite difficult to separate the isotopes of an element because they have identical chemical properties. This fact, of course, eliminates any chemical method of separation. Thus if one isotope is to be isolated from another, the isolation must be effected by a difference in physical or electrical properties of the isotopes.

Hydrogen, whose atomic weight is listed as 1.008, is composed of two isotopes having atomic weights of one and two. Long before they had any definite proof, chemists suspected that the heavier isotope existed. The actual existence of the isotope of hydrogen with an atomic weight of two was established by H. C. Urey, F. G. Brickwedde, and G. M. Murphy of Columbia University. They estimated that the ratio of H^1 to H^2 in ordinary hydrogen gas should be about 4500 to 1. They first took a sample of ordinary hydrogen and investigated it for the visible atomic Bolmer series spectra of H_2 by increasing the time of exposure so that the ratio of the time of exposure to the minimum time of exposure required to get the H^1 lines on the plate, was about 4000 to 1. Under these conditions, they found faint lines at the calculated position for H^2. Next, hoping to effect relative concentration of the H^2 atoms, they evaporated five liters of liquid hydrogen and collected the gas which evaporated from the last 2 cc. This gas when examined showed the H^2 lines greatly enhanced. This H^2 line did not agree in wave length with any known molecular lines; and so the experimenters concluded that it must be produced by the H^2 isotope.

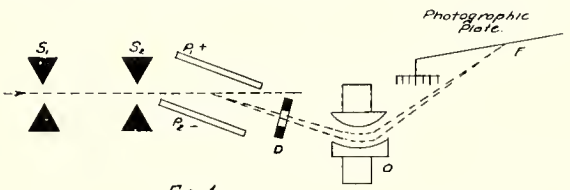


Fig 1

The establishment of the existence of the heavy isotope of hydrogen opened a very interesting field of investigation—that of water, in which the hydrogen would be entirely the heavier isotope. Such a compound would have the formula H^2H^2O. Its molecular weight would be 20. But what of its properties? Would it support organic life? How would it compare with ordinary water? Chemists set about to answer these questions by attempting to prepare a sample of water in which the two hydrogen atoms would each have an atomic weight of two.

The first discovery of a possible means of preparing such a sample of water was made quite by chance. A Mr. Ficklen, in Hartford, Conn. out of sheer curiosity determined the specific gravity of water contained in some commercial chromium plating baths, and he found the specific gravity of this water to be 1.00064. This value indicates 0.6 per cent. of the water to contain the heavier hydrogen isotope. This water had been in use for

about three years, with periodical additions of fresh water to make up for evaporation. No doubt the concentration of the heavy dydrogen isotope had been caused by the electrolysis to which it had been subjected during the chromium plating processes.

G. N. Lewis and R. T. MacDonald had the first real success in separating the hydrogen isotopes. Lewis and MacDonald started with the assumption, generally accepted by most chemists, that the concentration of H^2 to H^1 in ordinary water is about 1 to 30,000.

As it happened, in their laboratory was an electric cell which had been in operation for four years without change except for the addition of water to replace that which had been electrolyzed. Some of the water from this cell was distilled, and was found to have specific gravity of 1.00034 as compared to ordinary water at the same temperature. This very startling increase in density, if due to concentration of the H^2 indicated the presence of H^2 to the extent of 1 part per 3,000, or ten times the amount estimated to be in ordinary water.

They decided to further electrolyze the water. Some of the liquor from the cell was put into a beaker with two nickel plates as electrodes, and was electrolyzed with a current of 15 amps. until its volume had been reduced to about two-thirds of the initial volume. The electrolyte was then distilled, and the increase in density over ordinary water was found to be 50 per cent greater than before. This fact seemed to indicate once more that practically all of the H^2 was left behind.

These optimistic conclusions were suddenly overthrown by a simple calculation. The professor who had been using the cell was able to make a rough estimate of the amount of water that had been added during the life of the cell. Taking the original concentration of H^2 to H^1 as 1 to 30,000, it became evident that not more than one-third as much H^2 had ever been added to the cell as was being found there. This decrepancy might be explained in one of two ways. Either the concentration of H^2 in water is much greater than had been assumed, or the increase in density was not caused by the concentration of the hydrogen isotope alone, but by concentration of the heavier isotopes of oxygen which are initially present in much larger amounts.

Before their hydrogen isotope experiments, Lewis and MacDonald, who had been working on the isotopes of oxygen, found that it was possible to follow small changes in the ratio of the isotopes in water by careful measurments of the density. They obtained the specific gravity of a sample accurately to one part per million by finding the temperature at which a 10 cc. float will neither sink nor rise in ordinary water, and then finding the temperature at which this buoyancy balance was again established in the sample.

The possibility that any large accumulation of the heavy oxygen had occurred in the water obtained in the last-described electrolysis was eliminated in a very ingenious way. Some of the water, of which the temperature of the buoyancy balance was 0.31 deg. C. above that of ordinary water, was distilled in such a manner that the steam passed over hot iron wool where part of it was converted into hydrogen (part of the iron being converted to iron oxide). The gases passed on into a condenser from which the water was returned to the still, and the hydrogen continued into a tube of hot copper oxide where it was converted into water again, and condensed. A stream of hydrogen from an outside source was then passed over the iron oxide, producing a second sample of water. The first sample contained all of the hydrogen of the initial water, and the second sample, all the oxygen. This second sample had the density of ordinary water, and the first, which contained the hydrogen of the water under investigation only, showed again a difference of 0.31 deg. C. in buoyancy balance.

The experimenters were thus forced to the conclusion that the concentration of H^2 in ordinary water is much higher than had been estimated, approaching more nearly the value of 1 to 4500.

Lewis and MacDonald then began on a process designed to reduce to 1 cc. or less by electrolysis, ten liters of the water from the large electrolitic cell. In a large glass tube were placed eight parallel nickel plates, each 55 sq. cm. in area, connected alternately with the positive and negative leads. A helical copper tube through which cooling water flowed was introduced into the tube. A current of 250 amps. was used although this was reduced in the later stage of the electrolysis when the volume of the electrolyte became small. At the end of six days the electrolyte was reduced to one liter. This was placed in a smaller similar cell and electrolyzed to a volume of 100cc. In a fourth very small cell, which instead of having a cooling coil was surrounded by ice water, the volume of electrolyte was reduced to a little over half a cubic centimeter. The water thus obtained was found by means of a small pycnometer to have a specific gravity of 1.035; in other words, 31.5 per cent. of all the hydrogen was H^2.

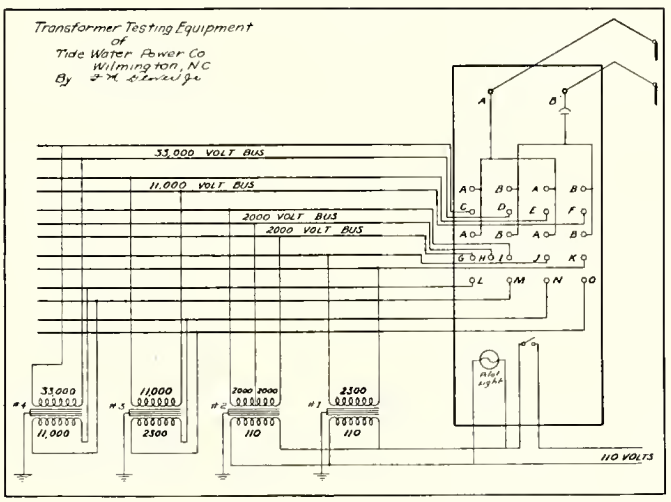
In the next series of experiments a change was made in the first electrolytic concentrator. The ten-liter glass cylinder was replaced by a 20-liter cylinder of monel-metal with external cooling, and the current was increased to 400 amps. In this second run, concentrating from 20-liters to 0.5 cc.,

(Continued on page 8)

Transformer Testing

By F. M. Glover, Jr.

Transformers play a vital part in the transmission and distribution of electric power. In power transmission, the step-up transformer is used to increase the voltage from the rated voltage of the generator to the desired transmission potential. The three most common voltages used for transmission are, 11,000, 33,000, and 110,000 volts; according to the length of the line. Transmission lines where 11,000 volts is the potential are generally from five to thirty miles long. Thirty-three thousand and 110,000 volts are used on longer transmission lines; their use being based on the cost of building and the efficiency. The higher the voltage on such a line, the greater the efficiency will be, for the power loss (I^2R) will decrease as the voltage rises.



The design of transformers for transmission lines and the design for distribution are different in some respects. The highest efficiency of a transformer will occur when the iron losses and the copper losses are equal. The power transformer, being under full load at all times, is designed to have the iron loss and the copper loss equal. The distribution transformer, being under full load from four to six hours and under a very light load the remainder of the twenty-four hours, is designed to give a low iron loss and consequently a high copper loss during the time of full load operation, and a low iron loss and a low copper loss while under light load operation.

The life of a transformer is indefinite—some transformers giving perfect service for many years after their design has become obsolete. There are times when the transformer is taken out of service for various reasons, such as to make changes in the voltages of the circuit, to repaint and renumber the transformer, or to replace the old leads with new leads. When a transformer is taken out of service it is put under a very rigid test, repaired, repainted, renumbered, and put back in service.

To enable a very rigid test on all sizes of transformers, transmission and distribution, every power company is compelled to have testing equipment set up in their transformer repair shop. The diagram shows the hook-up of the testing equipment used by the Tidewater Power Company at Wilmington, N. C.

The principle of the testing equipment is to take 110 volts from the ordinary house lighting circuit and build it up by the aid of step-up transformers to the desired testing voltage. The four transformers and busses are enclosed with fence wire (State law requires high voltage equipment to be enclosed) for the protection of the operator or anyone who may be in the shop. To explain the operation of the testing equipment, it is assumed that a 33,000 volt transformer is to be tested. Transformer No. 1 raises the voltage from 110 to 2300 volts, the 2300 volts being connected to receptacles J and K on the switch-board. This voltage is used to excite the 2300-11,000 volt transformer (No 3); receptacles J to N and K to O being connected by plug-in leads. The 11,000 volt side is then used to excite the 11,000 to 33,000 volt transformer (No. 4), connecting receptacles E to L and F to M by plug-in leads. This series of operations gives 33,000 volts at receptacles C and D. By connecting C to A and D to B the desired voltage of 33,000 volts is obtained on testing leads A' and B.'

To test a 2300 volt transformer, receptacles J to A and K to B are connected and the desired voltage is obtained at A'B'.

The actual test of a transformer embodies the following: test for open circuit, test for short of primary to secondary, test for short of primary to transformer case, and test for short of secondary to transformer case. In the open circuit test, the leads A' and B' are connected to the primary of the transformer and a series of electric lights are connected across the secondary. If the lights burn, the secondary circuit is good. In the test of primary to secondary, one lead is connected to one lead of the primary and the other to the secondary, if the circuit breaker does not open the

(Continued on page 16)

Miller Becomes Dean; Baity Is State Engineer

By EDWIN A. GASKILL

The honor accorded Dr. H. G. Baity by his appointment to the position of State engineer for the Public Works Administration reflects credit upon the University of North Carolina School of Engineering of which he is dean. On July twenty-sixth Dr. Baity was appointed to the State advisory board by President Roosevelt, but his appointment was subsequently changed to the position of State Engineer by Secretary of the Interior Ickes, August twelfth.

The duties that Dr. Baity is now performing are numerous. He is the executive of the State advisory board and as such he has been responsible for the organization of the office of the board and the employment of its personnel. He receives, records and examines all applications for federal aid and makes a complete report on them to the board. He also cooperates with the board in its efforts to stimulate the submission of public works projects, to inform the public of eligible projects and to demonstrate the advantages of borrowing money for public projects from the federal government.

APPOINTED ENGINEERING DEAN

RECEIVES NRA POSITION

Pictured above are Professor W. J. Miller, who was reeently appointed to the position of Aeting-Dean of the Engineering School, and Dr. H. G. Baity, who has relinquished his position as Dean to beeome State Engineer for the Public Works Administration.

The date of his return to the office of dean is indefinite. When he began his work as State engineer, the Engineering School chose Professor William J. Miller to fill his place for an indefinite period.

Professor Miller was born in Bee County, Texas, on December 12, 1893. He received his secondary education in the public schools of Skidmore, Texas from which he graduated in 1909. After attending Marshal Training School in San Antonio, Texas he entered the University of Texas in 1911. He graduated there in 1915 with the degree of B.S. in E.E. Following his graduation he held positions with several firms and institutions among which were the General Electric Co. and the University of Texas where he was promoted from the rank of instructor to the rank of adjunct professor. He became an instructor at M. I. T. in 1920 where he studied for a masters degree. His degree was awarded him in 1922. He held several positions of importance in commercial and educational fields. He came to the University of North Carolina from the Texas Technological College where he was Dean of Engineering and head of the department of Electrical Engineering.

Professor Miller is a member of a number of orders among which are the American Institute of Electrical Engineers, the Society for the Promotion of Engineering and Education, the National Electric Light Association, Tau Beta Pi, Masonic Order, and the Methodist church.

Besides serving as acting dean, he is teaching two graduate courses and directing research on third harmonic transformers.

THE HYDROGEN ISOTOPES

(Continued from page 6)

water of specific gravity 1.073 was obtained. In this water, 65.7 per cent. of the hydrogen was H^2. The experimenters calculated that if this last sample was reduced to one-fourth of its volume, the H^2 concentration would be 99 per cent.

Lewis and MacDonald proceeded with their experiments until they had 0.3 cc. of water in which, by their calculation, over 99 per cent. of the hydrogen was H^2. The specific gravity of this sample, however, proved to be 1.1059 as against 1.111 calculated for pure H^2H^2O, assuming the same molecular volume as for ordinary water. The sample was further electrolyzed until it was reduced to 0.12 cc. and its specific gravity was

(Continued on page 15)

The Purification of Sodium Chloride

By Blair Holliday

Since the time of the first civilized man, salt has been a substance necessary for the welfare of the human race. Man has used salt for many purposes, until comparatively lately using it mainly as a seasoning for food, but more recently also as a product from which to derive important chemicals.

This paper deals with the salt industry as it exists at the present time in the United States. In different sections of the country the method of treating the salt is radically different from that in other sections; this being due largely to the fact that climatic conditions, purity of the raw material, water supply and many other factors vary in the different sections. Specific plants which use the different processes will be used as examples to explain the different methods of treatment.

The first method of preparing salt to be described is the oldest method, that of solar evaporation. Although the oldest, it has rapidly decreased in importance in the United States in recent years, due to the introduction of more scientific methods and modern machinery. At the present time it is almost entirely confined to the drier parts of the country, especially to the vicinity of the Great Salt Lake in Utah and to parts of California.

The brines from the Great Salt Lake average about 20% solid material, approximately three-quarters of this being NaCl. The other one-quarter of the solid matter is made up of Na_2SO_4, $MgCl_2$, KCl, and slight amounts of a few other salts. Since this brine contains such a high percentage of solids, it is an ideal raw material from which to manufacture commercial salt.

The water from the lake is pumped to a number of settling ponds, each covering about 250 acres. The brine is allowed to remain in these ponds until it is a nearly saturated solution. The concentration of the brine is caused by solar evaporation. When the liquid has reached the right concentration it is allowed to flow by the action of gravity to smaller crystallizing ponds, or bitterns, each about ten acres in size. The fluid flows continuously through these crystallizing ponds all during the evaporating season of the year. The speed of the flow is regulated so that only NaCl will precipitate from the solution. The impurities are not present to the saturation point in the bitterns and therefore are not crystallized from the liquid. As the nights become cool in the autumn, the ponds are drained before the sun sets to prevent the precipitation of Na_2SO_4. As the autumn advances the daytime temperatures are such that Glaubers Salt will crystallize from the solution. When this time of the year arrives, the evaporating process is stopped and the salt accumulated in the ponds during the summer is harvested.

At the bottom of each crystallizing pond is a salt floor 12 to 15 in. thick. This floor is kept clean by the complete evaporation of a small amount of brine at the beginning of the evaporating season. During the summer the salt crystallizes on this floor to a depth of from three to five inches. At the end of the evaporating season the bitterns are drained off and the bed of salt is allowed to dry out. When the salt is dry, it is broken up by a tractor-drawn plow down to the "slit" or permanent floor. Next tractor-drawn scrapers and belt conveyors collect the salt from the ponds and pile it in huge dumps preparatory to sending the product to the refinery.

After the harvest and before the next evaporating season, rain and snow water dissolves the impurities that may crystallize during the cold weather. When this solution is drawn off the ponds are left clean and ready for the laying of a new floor coating of salt.

The salt is hauled in cars to bins in the refinery. From there, by means of a belt conveyor and a bucket elevator, it is fed into an oil-fired rotary kiln for drying. Inside the kiln the salt is heated by the hot gases from the carborundum-lined furnace. The furnace is kept at a temperature of 300° F. When the salt leaves the furnace, it is pure white, although rather dull owing to adhering fine powder. This fine powder is blown off the salt by a blast of air as it leaves the drying furnace. This dust consists mainly of Na_2SO_4, $10H_2O$ which was precipitated with the salt in the crystallizing ponds and which was dehydrated in the drying furnace.

The next treatment consists of crushing and screening the salt into the sizes desired for special purposes. Some of the grades made are: hay salt, stock salt, ice cream salt, special stock salt, No. 1 salt, No. 2 salt, cattle block salt, table salt and dairy salt. When the various sizes have been separated, each is packed in bags, barrels, or cartons to suit the needs of the intended consumer.

A second method of preparing salt is that used in the Ruggles and Rademaker salt plant at Mainistee, Michigan.

In the Mainistee district in Michigan, rock salt exists in large beds, approximately 30 feet in thickness, about 2,000 feet below the surface. The salt is removed from the beds by salt wells

drilled into the deposit. The wells consist of a number of concentric pipes. The first casing 14 in. in diameter is driven 300 ft. into the ground. Inside this pipe is a 10-in. pipe down 500 ft., inside of which is another casing 8 in. in diameter going down 600 ft., which in turn encircles a 4½-in. pipe in the very center which extends well into the salt deposit.

Over each salt well is a drill house, which contains the pumping machinery. Water flows down the outside pipes and filters through the earth until it reaches the salt bed. Here it dissovles the salt into a saturated solution of brine, which is then pumped to the surface through the inside pipe by compressed air. Each one of the wells has a capacity of about 150 gal. of brine per minute. As the salt solution arises from the earth it is piped into storage tanks to await purification.

From the storage tanks the brine is piped into 12 cypress-wood tanks, each having a capacity of 95,000 gal. In these tanks the brine is allowed to settle for a number of days and then the liquid is decanted off and sent to the evaporators. While in the tank such impurities as $CaSO^4$ and $MgSO^4$ drop to the bottom and are removed after each charge has been withdrawn.

In this plant two distinct types of salt are manufactured. One of these, the flake salt, is made by the "open grainer" or Michigan process; the other, the granulated salt is made by the vacuum-pan method.

The main equipment in the making of flake salt consists of great, shallow, open vats 120 ft. long, called grainers, each having a capacity of 23,000 gal. of brine. Steam coils suspended in the vats heat the brine brought from the settling tanks to a temperature just below the boiling point. By slow evaporation the water is removed from the solution. As the brine becomes more and more saturated, the salt precipitates to the bottom of the vat in flaky grains. The size of the flakes is controlled by regulating the speed of evaporation of the water, the faster the evaporation, the finer being the flakes. A temperature of 195°F gives a product in which the flakes are of optimum size for most uses.

Each grainer has a set of mechanical rakes for the removal of the precipitated salt from the bottom of the tank. The motion of the rakes is a reciprocal movement actuated by a hydraulic cylinder. At each forward stroke of the rake, salt is scraped along the bottom of the grainer for 8 ft. The grainers have the scrapers so placed that on each return stroke the preceding scraper overlaps the extreme working stroke of the scraper behind it. In this manner it takes the load of salt left on the last stroke of the scraper behind it and carries it forward another stroke for the next scrapper to catch. This process of being carried first by one scrapper and then by another continues until the salt has been conveyed to the end of the tank. Here it is slowly raked over an incline where a large portion of the entrained liquid drains back into the grainer. The salt is finally raked onto a belt conveyor which carries it to the vacuum filters where the first stage of drying takes place.

The salt made by the vacuum pan method has finer and more lustrous granules than that made by the grainer method. The vacuum pans or evaporators used in the vacuum pan method each consist of two cones whose bases are separated by an upright cylinder called a steam belt. The top and bottom faces of the steam belt consist of flue sheets connected by 22,000 copper flues through which the brine circulates. These vacuum pans each weigh 200 tons and have a capacity of 21,000 gal. of brine. The brine entering the evaporator from the settling tanks passes through the heating unit down the center well and then up through the tubes again. This cycle continues until the solution has absorbed enough heat from the steam belt to liberate steam. The vapor leaves the brine and then passes into a second evaporator to form the heating medium for it. The crystals of salt form at the top of the apparatus where the solution has the greatest concentration. As soon as a few of the crystals have formed there, the mass falls to the "boot" in the bottom of the evaporator from the effect of gravity on its mass.

The evaporators form a quadruple effect system. The multiple unit makes use of the principle that a decrease in pressure above the brine lowers the boiling point of the solution. The steam coming from one evaporator is condensed in the steam chest of the next one to heat and vaporize the brine contained in it. Due to the decreased pressure, the brine in the second evaporator boils at a lower temperature than that in the first one. In the best practice the brine in the last pan in the effect boils at a temperature of 86°F under a pressure of 1.5 in. of Hg. This reduction from the atmospheric pressure of about 29 in. of mercury is obtained by a large condenser and an air pump driven by a motor. The hooking of the evaporator in series saves a great deal of money which might be used to pay for making steam under a single effect system of operation. The only primary source of heat for the four evaporators in a quadruple effect hook up is the exhaust steam from the electric genera-

(Continued on page 13)

Activities of the Engineering Societies

A. I. Ch. E.

By Edwin A. Gaskill, Jr.

The local student chapter of the American Institute of Chemical Engineers held its first meeting of the year October tenth. In his opening address Bruce Old, president, emphasized the need for an organized program of activities. Inspection trips to neighboring plants, preceded by lectures given by the chemical engineers of the plants to be visited, and the presentation of films depicting industrial processes were suggestions for future programs. A program committee, to which were appointed Erwin Laxton, Richard Huber, Blair Holliday, and Henry Allison, was chosen to make plans for the year's activities. The business of the meeting was concluded with the election of Selby Harney to the office of treasurer, vacated by William Bateman.

Following the business of the meeting Dr. A. M. White read two interesting letters from former students who wrote of their experiences with starting their industrial careers.

The meeting was ended with the serving of refreshments.

Much was accomplished at the meeting on November seventh. A moving picture was ordered. Erwin Laxton was chosen to make arrangements for an inspection, on November twenty-fifth, of one of the Durham tobacco plants. The announcement was made that Mr. Harry A. Curtis, head of the chemical engineering department of the Tennessee Valley Authority, would speak on Chemical Engineer's Day. Dr. White gave a short biography of Mr. Curtis.

The speaker of the evening was Dr. Cameron of the Chemistry department, who spoke on "The Industrial Chemist's Job." Refreshments followed the lecture and the meeting was adjourned.

A. S. C. E.

By W. W. King

The society has had three regular meetings and one joint meeting this fall on alternate Thursday nights. The officers for this year are as follows: F. E. Culvern, president; R. M. Dailey, vice-president; S. Franklin, secretary; and W. H. McNairy, treasurer.

At the first meeting of the year plans for the coming year were discussed and a program committee consisting of F. E. Culvern, J. T. Stallings, and W. W. King appointed. Professor Hickerson, faculty advisor for the chapter, explained the purpose of the American Society of Civil Engineers and the work of the student chapters. He stated that the local chapter is named in honor of William Cain, former professor of engineering in the University. He also said that the late Dean Braune has a chapter named in honor of him at the University of Cincinnati.

Mr. J. D. Watson, member of the civil engineering faculty, spoke at the second meeting on the Mississippi Valley Flood Control. Mr. Watson gave an interesting account of the work of the government engineers. Sidney Franklin and R. M. Culvern showed some slides lent the chapter by the national society.

The society was fortunate in having O. B. Bestor, engineer of permanent surveys and records, of the state highway commission, as its speaker at its last meeting. Mr. Bestor explained the work that has been done by the U. S. Coast and Geodetic Survey in North Carolina and told of the supplementary monumentation being done by the state highway commission.

Other activities of the society have included an inspection trip by the senior members under the supervision of T. P. Noe, instructor in civil engineering. The seniors inspected the plant of the Carolina Steel and Iron Company in Greensboro.

A. S. M. E.

By E. L. Kendrick

The local student chapter of the American Society of Mechanical Engineers is under the leadership of the following officers who were elected last fall to serve during the present school year:

Professor N. P. Bailey, honorary chairman; Mr. P. R. Hayes, chairman; Mr. Calder Atkinson, vice-chairman; Mr. E. L. Kendrick, secretary-treasurer.

Two major meetings have been held this quarter. The purpose of the first meeting was to acquaint the prospective members with the aims and purposes of the society. Paul R. Hayes, chairman, pointed out in his introductory talk that membership in the society served the need for contacts with successful and practical engineers. Professor N. P. Bailey, honorary chairman, also spoke on the reasons why all mechanical engineering students should become members of the leading society of their chosen profession.

The second meeting, an annual affair, was held in Raleigh jointly with the State College student branch and the Mechanical Engineering Society of Duke University at the invitation of the Raleigh section of the A. S. M. E. At this meeting,

Mr. E. E. Williams, superintendent of steam plants for the Duke Power Company, gave a very interesting talk on "The Need for Engineering Leadership in the World Today." A weiner roast was held in the Forge Shop after the meeting.

Plans are being made for the showing of several movies of recent developments in the mechanical engineering field at meetings to be held during the winter and spring quarters.

A. I. E. E.

By S. H. USRY

The student chapter of the A. I. E. E. held its first meeting of the fall quarter, October 10. The purpose of this meeting was to acquaint the new members of the society with the purposes and aims of the A. I. E. E. Chairman C. M. Garrison gave a brief talk on the purposes of the society. Professor W. J. Miller gave a very interesting talk on the advisability of the students joining the national society while in school. The meeting was adjourned with an inspection of the electrical laboratories.

The next meeting held was a meeting of the state section of the A. I. E. E. on November 1, 1933. At this meeting several interesting talks were given. The final talk was an illustrated lecture on "Television," delivered by Dr. J. O. Perrine of the Bell Telephone Laboratories.

TAU BETA PI

By W. W. KING

The North Carolina Beta chapter of Tau Beta Pi held its annual fall tapping Thursday, October 19, in Phillips Hall. Dean Baity was the principal speaker and told of the NRA's public works program in North Carolina. After Dean Baity's talk the following men were tapped by the society in an impressive ceremony: B. S. Old, S. S. Meyers, and R. M. Dailey, seniors; and J. B. Crtuchfield, W. W. King, and E. L. Laxton, juniors. To have been eligible for election these men had to have a scholastic standing in the upper fourth of the senior class or the upper eighth of the junior class. Other members of the society are: W. L. Ridenhour, Edward Brenner, P. R. Hayes, F. E. Culvern, J. R. Marvin, and Sidney Franklin. Dr. A. M. White is faculty advisor.

The fall initiation was held in Graham Memorial, November 3 and was followed by a banquet. Acting-Dean Miller was the principal speaker and spoke of the engineer and future conditions. President Ridenhour reported on the national convention which he attended in Chicago.

WITH THE ALUMNI

By F. M. GLOVER, JR.

(EDITOR'S NOTE: *As is apparent, this list is far from complete. Only a few of the alumni graduating in the last three years are listed, as only their addresses were available. Other alumni are requested and invited to send in their addresses and information pertaining to their occupation.*)

CLASS OF 1931

BROWN, J. L. (M.E.), Health Inspector, City of Concord, Concord, N. C.

DAVIS, E. L. (E.E.), Substation operator, Duke Power Co., Duncan, S. C.

COWPER, MARION (C.E.), Inspector, State Board of Health, Raleigh, N. C.

PARSLEY, ROBERT A., Jr. (M.E.), Office force, Standard Oil Co., Wilmington, N. C.

RIDDICK, THOMAS (C.E.), Instructor of Sanitary Engineering, N. Y. U., New York City.

CLASS OF 1932

ALFORD, G. H. (E.E.), Substation work, Duke Power Co., Thomasville, N. C.

ANDREWS, JOHN (C.E.), State Board of Health, Raleigh, N. C.

ATKINSON, BILL (C.E.), Clerk, Peoples Bank, Wilmington, N. C.

CADMUS, R. C. (E.E.), Bethlehem Steel Corp., Maintenance Dept., Bloomer Mill, Baltimore, Md.

CHOATE, PAIGE (E.E.), U.S. Dept. of Agriculture, Forest Service, Collettsville, N. C.

DULS, JAMES (M.E.), Draftsman, Columbia Gas & Electric Corp., New York City.

MATHEWS, MILLENDER (Ch.E.), Assistant Chemist, American Enko Corp., Asheville, N.C.

McIVER, HENRY (C.E.), Football coach, High Point High School, High Point, N. C.

CLASS OF 1933

BLACK, F. S. (E.E.), Salesman, Electrical Appliances, Nautabala Power & Light Co., Bryson City, N. C.

BURNETT, R. T. (E.E.), Shipping Clerk, Ralph C. Erskine, Inc., Tryon, N. C.

COWHIG, R. K. (M.E.), Parts Dept., Chevrolet Plant, Charlotte, N. C.

HUNTER, J. E. (E.E.), Tax Assessment Commission, Asheville, N. C.

KELLENBERGER, C. D. (M.E.), Graduate School of University.

LAXTON, F. M. (E.E.) Vice-president, Tucker & Laxton Co., General Contractors, Charlotte, N. C.

MARVIN, J. R. (E.E.), Teaching Fellowship at University.

McLEAN J. A. (M.E.), Charlotte Parks Commission, Charlotte, N. C.

MILLER, W. G. (E.E.), Westinghouse Electric & Mfg. Co., East Pittsburgh, Penn.

THE PURIFICATION OF SODIUM CHLORIDE

(Continued from page 10)

tors used in the steam chest of the first evaporator.

The concentrated mixture of salt and brine which is removed from the boot of the evaporating pan is conveyed to a vacuum filter which washes the salt and performs the first stage of drying.

Flake salt and granulated salt are given the same kind of final drying after they come from the vacuum filters. For some purposes, notably for bulk trade, the salt is air-dried. About 22.5% of the total production is treated in this manner. The air drying is accomplished by simply spreading the salt out on the warehouse floor for a considerable length of time and letting the moisture drain and evaporate away. Refined salt is for the most part, kiln-dried. This drying is done in a revolving steel drum 32 ft. long and 6 ft. in diameter. The drum is lined with Monel metal to prevent discoloration and contamination of the salt. This drum is fed with salt and is revolved while a stream of air at a temperature of 1800°F is blown through it the length of the drum. The capacity of each drum is from 4 to 20 tons of dry salt an hour, the amount depending largely upon the type of salt being dried. The salt passes the length of the drum in about 30 minutes.

From the final drying process the salt passes onto a set of screens. The screens grade the salt according to size. From the screens the salt falls down chutes to large storage bins, each grade and size having a different compartment.

The salt from the bins goes directly to the weighing and packing machines except in the case of the table salt. This type of salt is first mixed with 0.02% of KI to iodize it and then with 1% of a filler to prevent absorption of moisture and consequent hardening. On one floor of the refinery package shells for table salt are wrapped with the labels and are then dropped down to the next floor where they are filled, weighed, and sealed by machinery. The salt which is not designed for table usage is packed in various other ways depending upon the final use to which it is to be put.

The third part of this article is concerned with the processing of rock salt in the Texas region. The plant to be used as an example of the salt industry in this district will be that of the Morton Salt Company at Great Saline, Texas.

Rock salt mining in the Gulf district differs from that in other parts of the country, primarily because of the greater purity of the raw material. The plant at Great Saline is really a coarse-salt mill, producing grades of salt similar to those at the mines in Michigan, New York, and Kansas, combined with a fine-salt mill, producing salt of the same type as that made by the evaporating plants in various sections of the country. The actual plant layout is so arranged that in one mill are produced what are normally considered two distinct mill types of salt.

The plant is divided into two structures connected by an inclined belt conveyor gallery. Inside the head-frame structure the raw salt receives its primary treatment. After passing through a primary crusher on the floor of the mine shaft, the salt is hoisted to the surface and is then dumped into large re-enforced concrete storage bins lined with vitrified brick, where it stays until its turn for purification comes.

From the storage bin the salt is carried on a reciprocating plate feeder to a shaking picking table where it is inspected. When any discolored salt is found on the inspection table it is removed from the main body of the salt and is sent to a crushing machine where it is broken into small pieces. The crushed product is then sent to a brine tank of re-enforced concrete and brick. After the salt has been dissovled the saturated solution is allowed to stand. The insoluble material is allowed to settle to the bottom of the tank and is periodically flushed out. The brine is decanted from the tank and is sent to an exaporating plant to be dried.

The salt which passes the inspection on the picking table is sent to the crusher, where it is broken to pieces about the size of 1-in. cubes. From here it is carried on an 18-in. rubber belt conveyor on a 15-deg. incline to the main mill.

In the main mill the salt is screened through a series of sieves until the salt is thoroughly sized. A special feature of this mill lies in the fact that all the sizes produced in the fine-salt mill are made here, not by screening of the mill run below 10 mesh, but by grinding some of the larger sizes down to the desired dimensions. Experience in the salt industry has shown that the best grades of fine salt, that is those with the most uniform crystals, are made by grinding large crystals of some particular size.

After the milling operation is complete the various grades of salt pass either by chutes or conveyors to a series of bins from where they are drawn to fill packages or to be carried away in bulk.

Salt is one of the most important substances known to mankind. It is not only used in great quantities as a seasoning for food, but also as a material from which to manufacture many important industrial chemicals. Some of the important substances made from NaCl are Na^2CO^3,

NaOH, Cl, in bleaching powder, HCl, Na^2SO^4, $CaCl^2$, NH^3, and $(NH^4)^2SO^4$.

In 1925 the world's production of common salt was about 25,000,000 tons. Of this amount the United States produced 7,397,500 tons. The other countries whose production reached 1,000,000 tons or more were France, Germany, Great Britain, China, and India.

THE HISTORY OF COMMUNICATION

(Continued from page 4)

netic induction. In 1842 Henry pointed out that in certain instances the discharges from Leyden jars were oscillatory, and in 1855 Lord Kelvin by mathematical reasoning predicted the conditions under which the discharge would not be oscillatory. About this time James Clerk Maxwell began to apply his mathematical genius to electricity and in 1855 brought out his Electromagnetic Theory of Light. He stated the properties of electric waves in air and predicted they would travel with the speed of light.

The first successful radio communication was made in 1865 by Dr. Mahlon Loomis, a dentist of Washington, D. C. He built an oscillating circuit and connected it to an aerial wire supported by a kite. One station was on top of Bear Den Mountain in Virginia and a duplicate station was set up on top of Catoctin Spur, some fifteen miles distant. Messages were sent alternately from one station to the other by dot-and-dash interruption of a buzzer spark circuit; reception was attained by the deflection of a galvanometer needle at the station which was at the moment receiving.

On June 1, 1894, Lodge, using a 5-in. sphere placed between two small secondary coil knobs as a radiator and a contact coherer as detector, transmitted signals over a distance of some 30 yards. About 1895, in Italy, Marconi was experimenting with Hertzian waves and succeeded in producing a metal filings coherer which was much more sensitive and dependable than that of Branly. Marconi came to England and continued his experiments with perseverance and in 1897 obtained satisfactory communication over 9 miles.

The improvement of means of detecting Hertzian waves was coincident with the development of means to produce them. In 1902 Marconi introduced his magnetic detector for telephonic reception, and about the same time the sensitive electrolytic detector, consisting of a fine platinum point dipping into dilute sulphuric acid, was introduced in America. Dunwoody invented the carborundum crystal detector in 1900 and it practically held the field for spark reception up to 1914. In 1904 Fleming introduced his thermionic valve and showed that it acted as a rectifier of high frequency currents. It was used extensively for wireless telegraphy, but although a rival, it did not supplant electrolytic and crystal detectors. In 1907, De Forest made one of the most important advances in the history of radio by introducing the grid into the Fleming valve.

Development of the transmitting side was also taking place in the construction of alternators capable of producing very high frequencies. Fessenden in 1907 produced an alternator of two kilowatts output and a frequency of 100,000 cycles, and in 1916 Alexanderson had a high-frequency alternator on the trans-atlantic service which generated directly 22,000 cycles and a power of 200 kilowatts. These alternators energizing the antenna produced continuous waves in the ether, considerably improving the range and reliability of transmission, reducing the interfering properties of the transmitter, and increasing the selectivity of reception.

There is no need to deal with the phenomenal growth of the broadcasting industry, which is now one of the largest industries in the country, or the continued improvement of receiving sets since the World War. These facts are familiar to everyone.

The most successful system for transmitting pictures over wire is that developed by the American Telephone and Telegraph Co. In the transmitter the film picture is inserted in the machine simply by rolling it up in cylindrical form and slipping it into a drum. During operation a very small and intense beam of light shines through the film upon a photo-electric cell within the drum. In the receiver the sensitive film is put on a rotating cylinder and turns like the cylinder record on a phonograph, and a point of intense light constantly varied according to the darkness or lightness of the original photograph falls on this film. Both sending and receiving drums are maintained in synchronism by impulses sent over a separate channel.

For the transmission of radio photographs, either the Jenkins prismatic disc system or the scanning disc is used. In the Jenkins system, prismatic discs with constantly changing reflective angles are used to sweep the light beam across the picture being transmitted. The only successful method in any commercial use today of transmitting and receiving moving pictures by radio is the scanning disc system. However, a system has been recently developed that uses cathode ray tubes as both transmitting and receiving elements, in conjunction with conven-

tional transmitting and receiving apparatus.

In concluding it is interesting to compare the speed of communication as it was some 100 years ago and as it is today. In the early part of the nineteenth century it would have taken 13 days for a horse and rider going as hard as they could and traveling 24 hours a day at an average speed of 10 miles per hour to carry a message from New York to San Francisco. Correcting this time for stop-overs and the fact that the riders and horses could only travel 12 hours per day, 30 days does not seem to be too large an estimate of the smallest time in which a letter could cross the continent. Today, within a few minutes, anyone in New York may get in touch with anyone in San Francisco and actually converse with them over the telephone!

THE HYDROGEN ISOTOPES

(Continued from page 8)

found to be 1.1053. It was assumed, then, that the water had been electrolyzed to constant density, and the specific gravity was taken provisionally as 1.1056 at 25 deg. C.

Although their sample was small, the scientists were now in a position to determine some of the properties of their new compound. Heavy water was found to have a freezing point of +3.8 deg. C and a boiling point of 101.42 deg. C. Its vapor pressure was compared with that of ordinary water, and the results are given in the following table where P_1 is the vapor pressure of common water, P_2 is that of H^2H^2O, and t is the temperature in degrees Centigrade.

P_1-P_2	2.3	3.9	6.1	9.1	13.1	18.0	23.9	30.7	38.4	47.0
P_2-P_1	.87	.88	.89	.90	.913	.923	.933	.942	.949	.956
t	20	30	40	50	60	70	80	90	100	110

An experiment to determine the affect of H^2H^2O on plant life has been conducted, and the results obtained are rather startling. Because of the lack of water, minute tobacco seeds were selected to be tested. Twelve seeds were placed in pairs in six similar glass tubes, and to each of three tubes, 0.02 cc. of ordinary distilled water was added, and to each of the other three tubes, .02 cc. of H^2H^2O was added. The six tubes were hermetically sealed and placed in a thermostat at 28 deg. C. The three pairs of seeds in ordinary water sprouted in two days, and in two weeks formed well-developed seedlings. The three pairs in H^2H^2O showed absolutely no development!

The separation of any isotopes to allow spectroscopic study and the examination of chemical and physical properties, furnishes a fascinating study. This is especially true with the isotopes of hydrogen because the properties of the heavier isotope differ so from those of the lighter that the heavier isotope may be regarded as almost a new element. Perhaps some of the hydroxides will be markedly changed in properties when made with H^2. Think of the physical constants that must be determined for the thousands of hydrocarbons and carbohydrates when they are made with the heavy hydrogen!

THE ENGINEERS' BALL

(Continued from page 2)

girls to the dance, and their only contribution to the success of the dance has been the sometimes doubtful value of their presence. It is also believed by the students advocating the proposal that closing the dance will tend to make the dance more enjoyable. It is easily apparent that the engineering students will enjoy the dance more if only those are present whom they know.

Another feature of the proposal as advocated is that persons who have been drinking excessively shall be escorted gently, but firmly, to the door. It is no secret that, on the campus, the annual dance is referred to as the "Engineers' Brawl." This has been largely due to the fact that the dance has been generally considered a drunken spree. The excessive drinking at the dance each year has caused a sharp decrease in the number of girls brought to the dance by engineers. There is no need to mince words. This has been caused by the fact that, while far from true in *all* cases, certain of the girls brought to the dance have been of questionable reputation.

These conditions have, no doubt, been largely due to the undeservedly bad reputation into which the dance has fallen. This state of affairs can easily be remedied by making the dance, in truth, the "Engineers' Ball," and by discouraging excessive drinking. There is no reason why the Engineering School cannot give a dance equal to any on the campus insofar as the social prestige of the girls present is concerned, and the success of the dance can be aided immeasureably by making the dance one for, by, and of the engineers.

Compliments of

The Hill Dry Cleaners

"Student Service to Students"

PHONE 5841

ANNUAL CLASSIC DRAWS NEAR

By DAME RUMOR

A spirit of nervous tension has become prevalent throughout the Engineering School within the past two weeks. Erudite seniors have forgotten to cut their Saturday 8:30's, juniors have been making the unpardonable sin of handing in reports on time, mysterious rumblings of plots and counterplots have been heard throughout Phillips hall. The only explanation offered for these activities is the approaching date of that gridiron classic, that gigantic struggle of brawn and brains, that colossal example of the application of engineering brains applied to a popular pastime, the annual Mechan-Elecs—Civic-Chems football game.

The coaches for the opposing teams have absolutely refused to let out the least bit of information concerning their tactics for the game. However, Dame Rumor gets around, and we understand Co-coaches "Pop" Hoefer and "G.E." "Johnny" have evolved a new end run called the "slip-stick shuffle," which they believe will throw the battle to their charges, the Mechan-Elecs. However, the Civi-Chems are not to be outdone. Their Co-coaches, "Shorty" White and Col. Hickerson have gone into a crap-shooting formation and come out with a new passing attack which depends, however, for its success upon the allowable unit stress in the passer's arm and the overall coefficient of transfer from passer to receiver.

The game, which is tentatively dated for December 9, is expected to draw only a small crowd of 125,000 spectators due to the depression. Special trains are being run from California, Oregon, and Washington for the game. As yet, no referee has been selected.

Although, the engineers are adverse to playing post-season games, it is rumord that the winner of the struggle may take on Louis Graves' undefeated "Ink-slingers" in a special milk-fund charity game.

TRANSFORMER TESTING

(Continued from page 7)

coils are not shorted, if the circuit breaker opens the coils are shorted. In the test of primary and secondary to the case, one lead is connected to the case and the other to one lead on the primary, and vice-versa for the secondary to the case. If there is a short the circuit breaker will open.

If the transformer passes these tests it is checked for cracked bushings, worn leads, and bad insulating oil. If the transformer shows a primary to case short or secondary to case short, all the bushings and leads are checked to find the trouble. After the trouble is located, the transformer is repaired and put back in service. In case the transformer shows a primary to secondary short, it is discarded without an attempt to repair it.

The transformer is then connected as described and the calculated value of voltage is impressed on the primary coils. To successfully perform this operation the transformer should be kept on the line for about twenty-four hours to drive out all of the water and moisture that had collected in the coils.

During the past years there have been several cases of electrocution by persons coming in contact with, presumably, a 110 volt line, when, at that time, there was a short from primary to secondary in the transformer, putting about 2300 volts on the 110 volt line furnishing the power. Cases such as these show why the tests on transformers must be rigid and accurate.

The Bayonne Bridge has been selected the "most beautiful bridge of steel" by the American Institute of Steel Construction. The bridge is the longest single arch in the world and the length of the arch span is 1,675 feet.—*Fortune, Sept. '33.*

COMPLIMENTS

of

Johnson-Prevost

Dry Cleaners

PHONE 7011

Happy — Snappy — Service

Benson Plumbing and Heating Company

Practical Service

Automatic Coal Stoker

Oil-O-Matic Oil Burners

Office Phone 5281
Res. Phone 4506

Atwater & Poe Auto Service

Repairing, Greasing and Painting
On All Makes of Cars

Reasonable Prices

PHONE 6581

N. Columbia St. Near Fire Station

CAMERAS Loaned Free

Film Service

Prompt Delivery

Minimum Prices

FOISTER PHOTO CO.

Largest Kodak Finishing Plant in North Carolina

O'Kelly Tailoring Co.

Oldest in Town

There Is a Difference
In Dry Cleaning

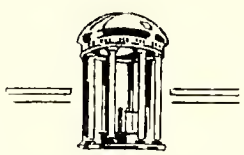
Have Your Clothes Cleaned by the Best Methods

Phone 3531 Columbia St.

Attention Engineers

Engineering Demands Speed and
Accuracy. Be Proficient in Both.
Get Your Slide Rule Now -- Know
How to Use It by Next Quarter.

The Book-X Carries Complete Supplies for Engineering Students



The Book Exchange

Chapel Hill, North Carolina